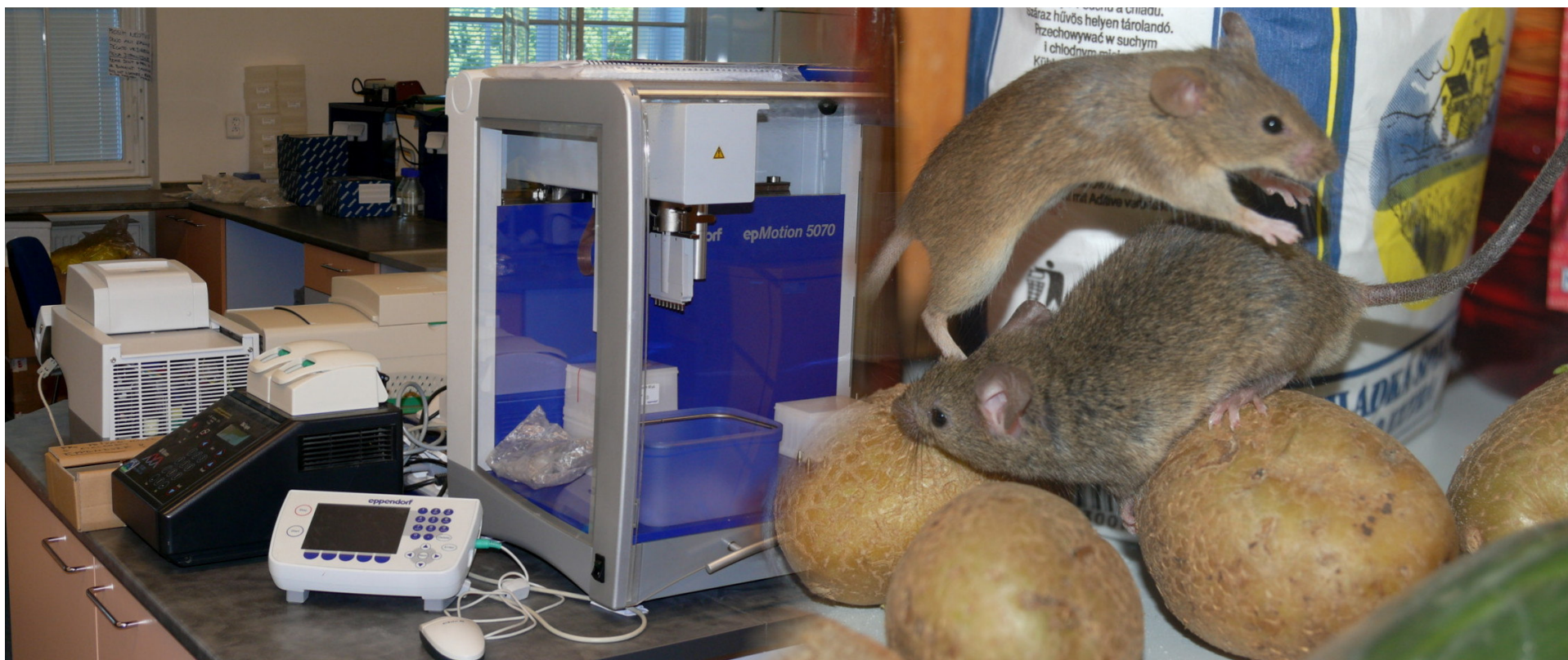




Complex genetic architecture of the house mouse nascent species hybrid zone

Pavel Munclinger

Department of Zoology, Faculty of Science, Charles University in Prague, Czech Republic



Talk overview

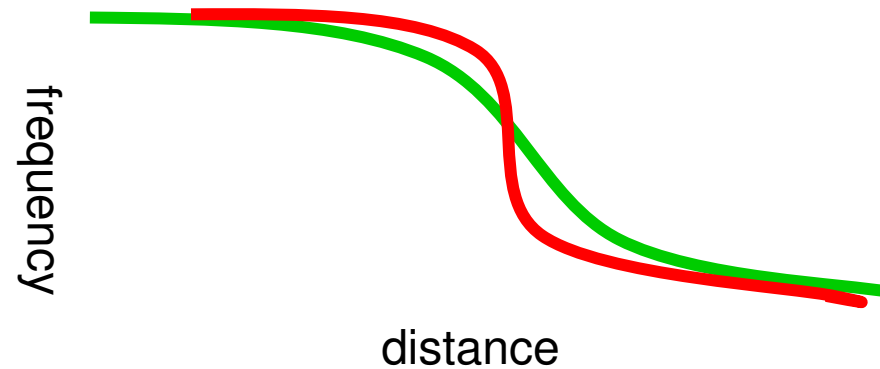
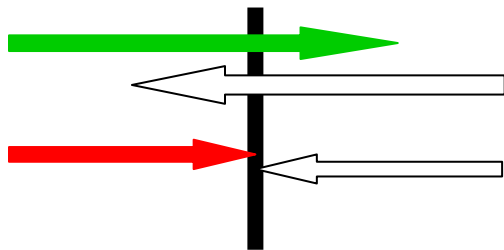
- Hybrid zone as speciation laboratories
- House mice as optimal model organisms
- Summary of house mouse hybrid zone studies
- Our results
- Future of the house mouse hybrid zone studies

How can we study speciation genetics?

- Experimental hybridization
- Natural hybridization

Tension zone

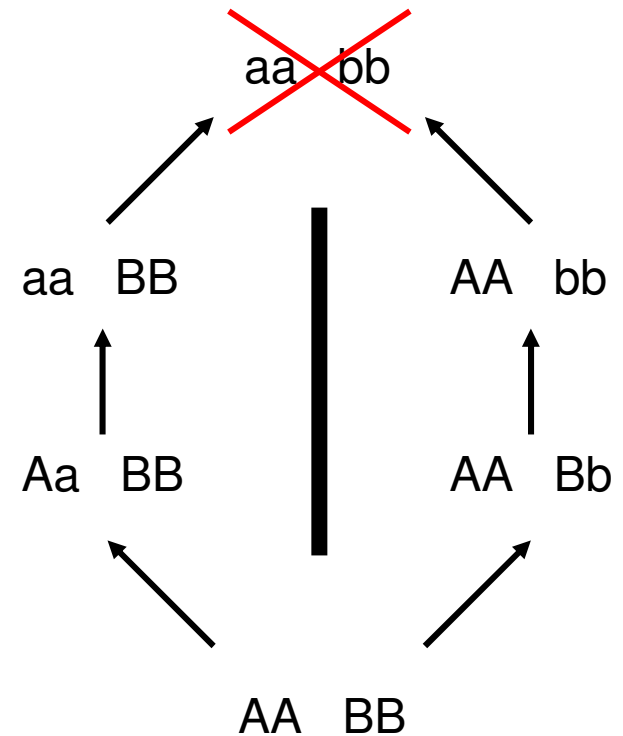
- Maintained by a balance between dispersal and selection against hybrids
- Parallel clines
- The steepness of clines reflects the intensity of selection against hybrid genotypes



Steep clines → regions of genome containing the reproductive isolation genes

More genes involved in intrinsic isolation

- Bateson-Dobzhansky-Muller model
→ at least two genes
- Many loci under weak selection
- Significant linkage disequilibria
- Sharp steps at the centres of clines



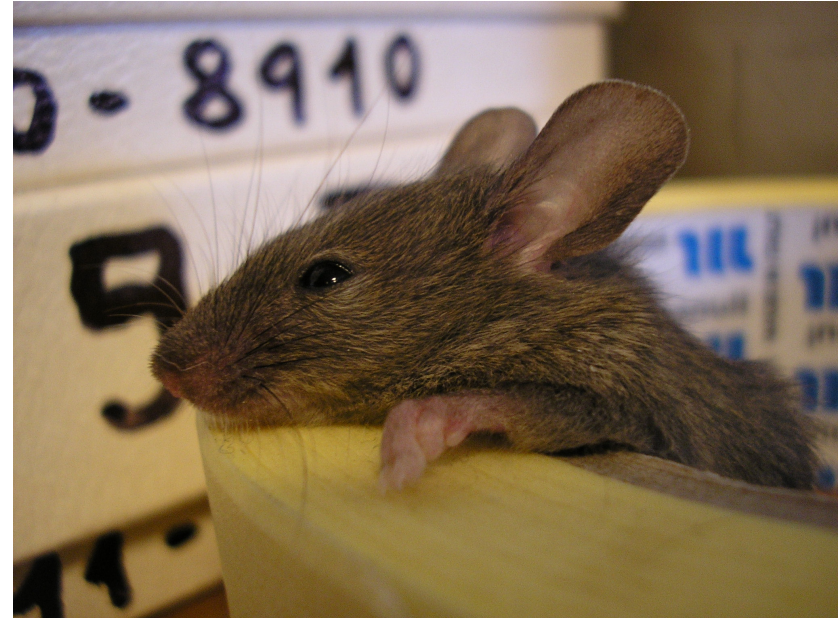
Hybrid zone theory → Estimates

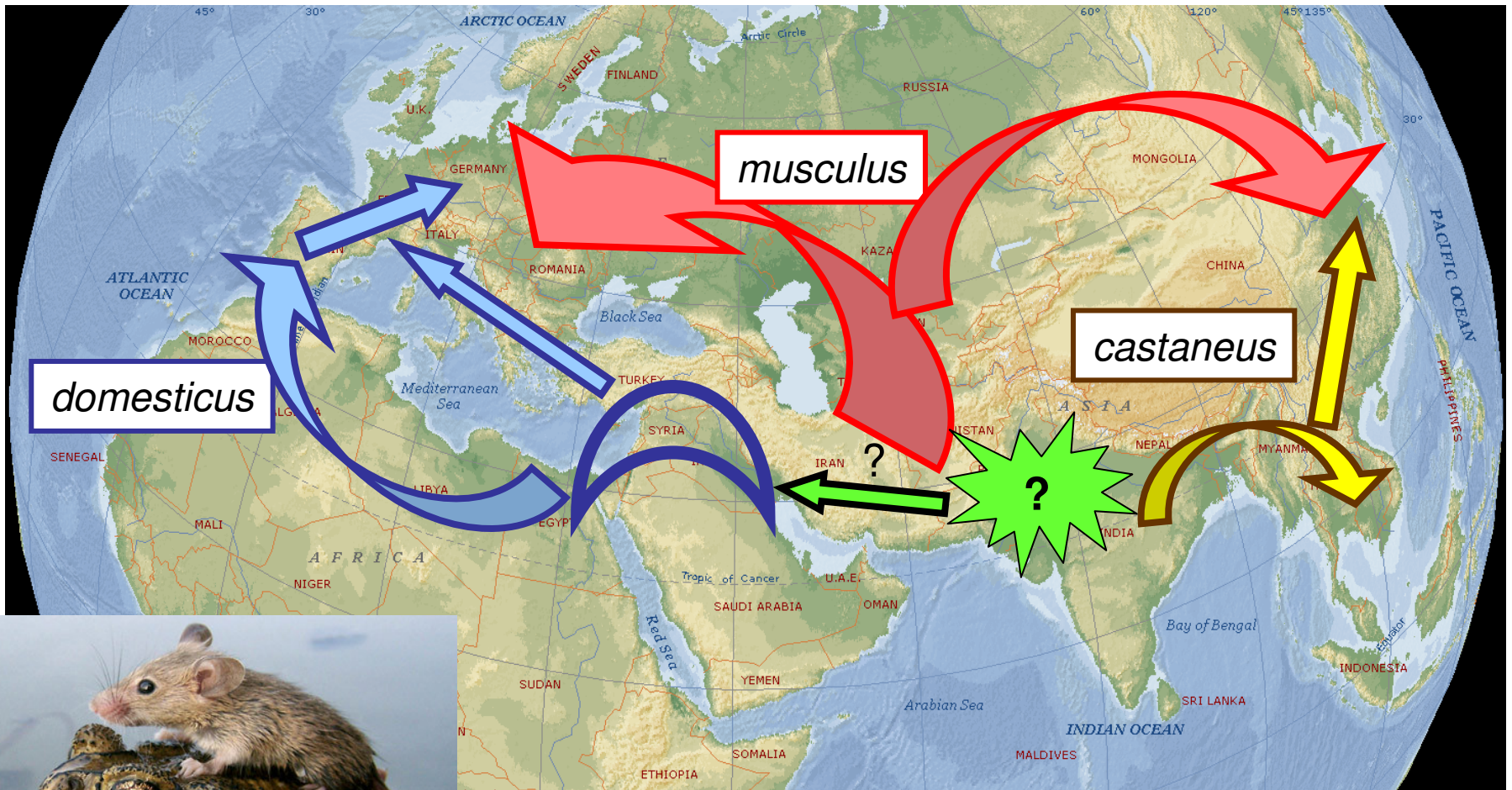
- Cline width
- Fitness of hybrids
- Selection against hybrids
- Number of loci under selection

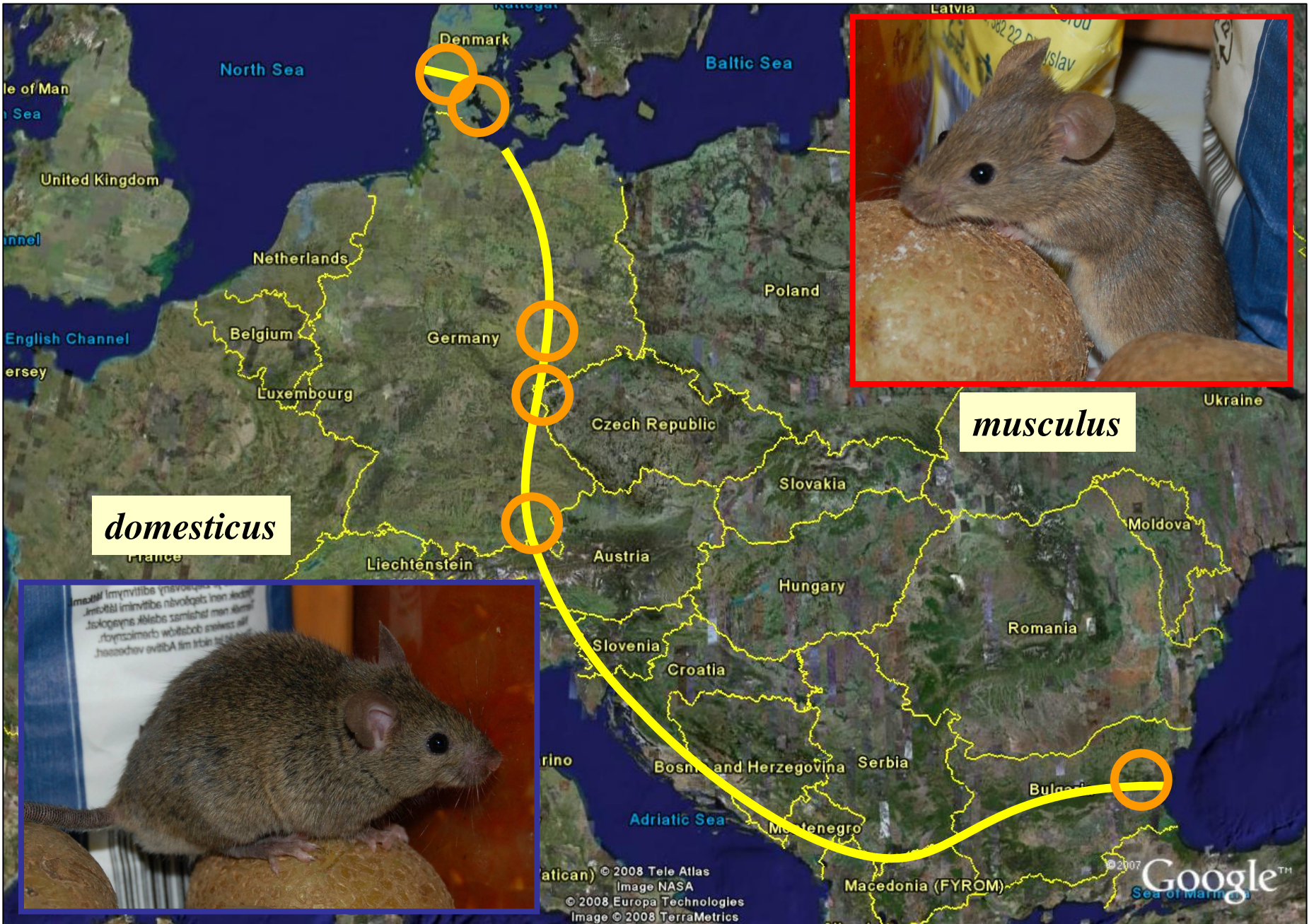
House mouse as a model species

- Easy to find and trap
- Easy to breed in lab
- Sequenced genome
- Many markers
- Genes of known function

- **Hybrid zone**







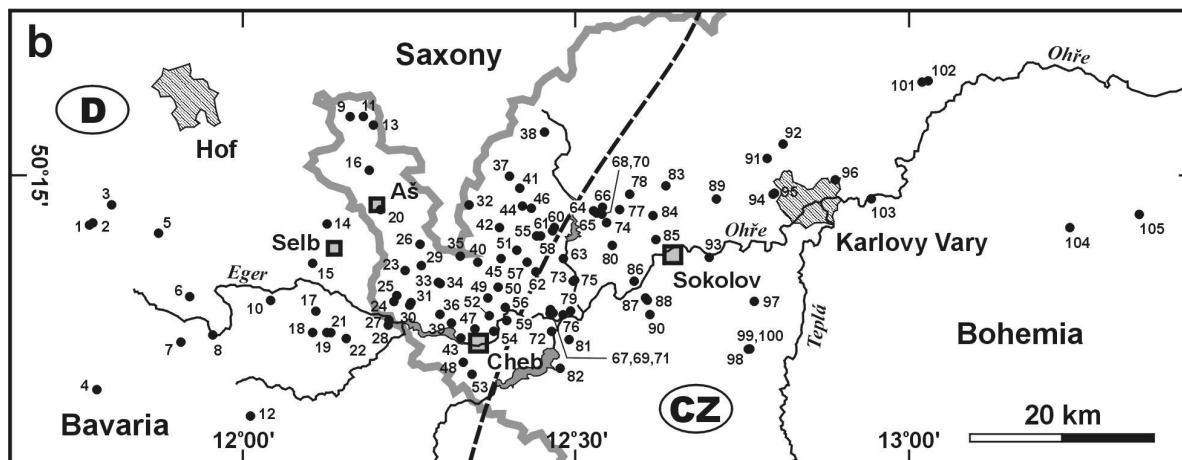
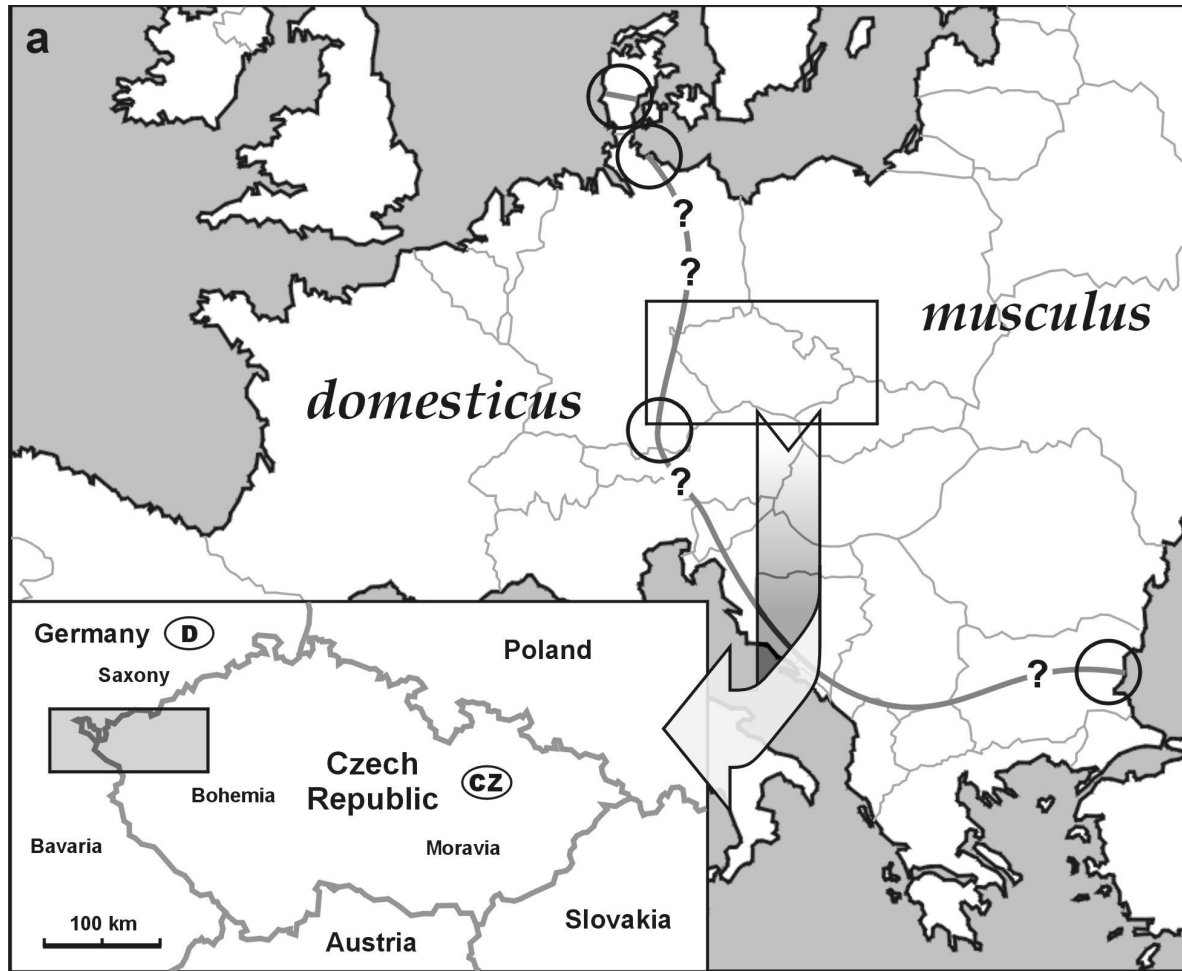






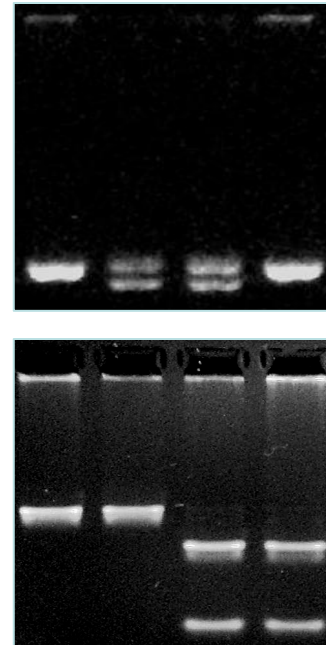






Markers

- Allozymes
- PCR-RFLP markers
- Deletions
- SNPs
- Transposon insertions



Commensal species

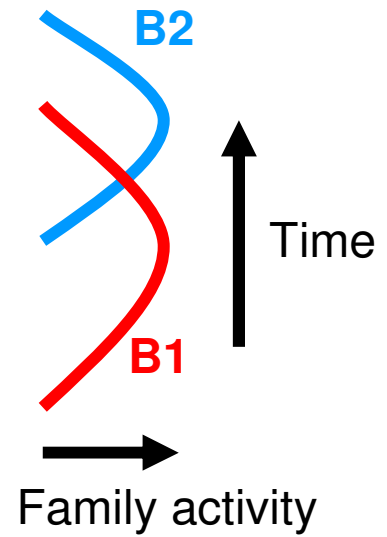
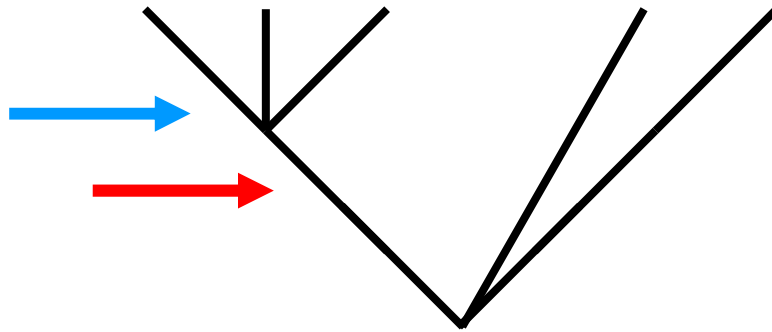
Free-ranging species

M. musculus

musculus *domesticus*
castaneus

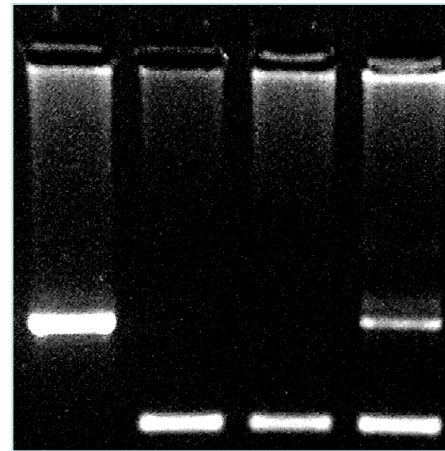
M. macedonicus

M. spretus



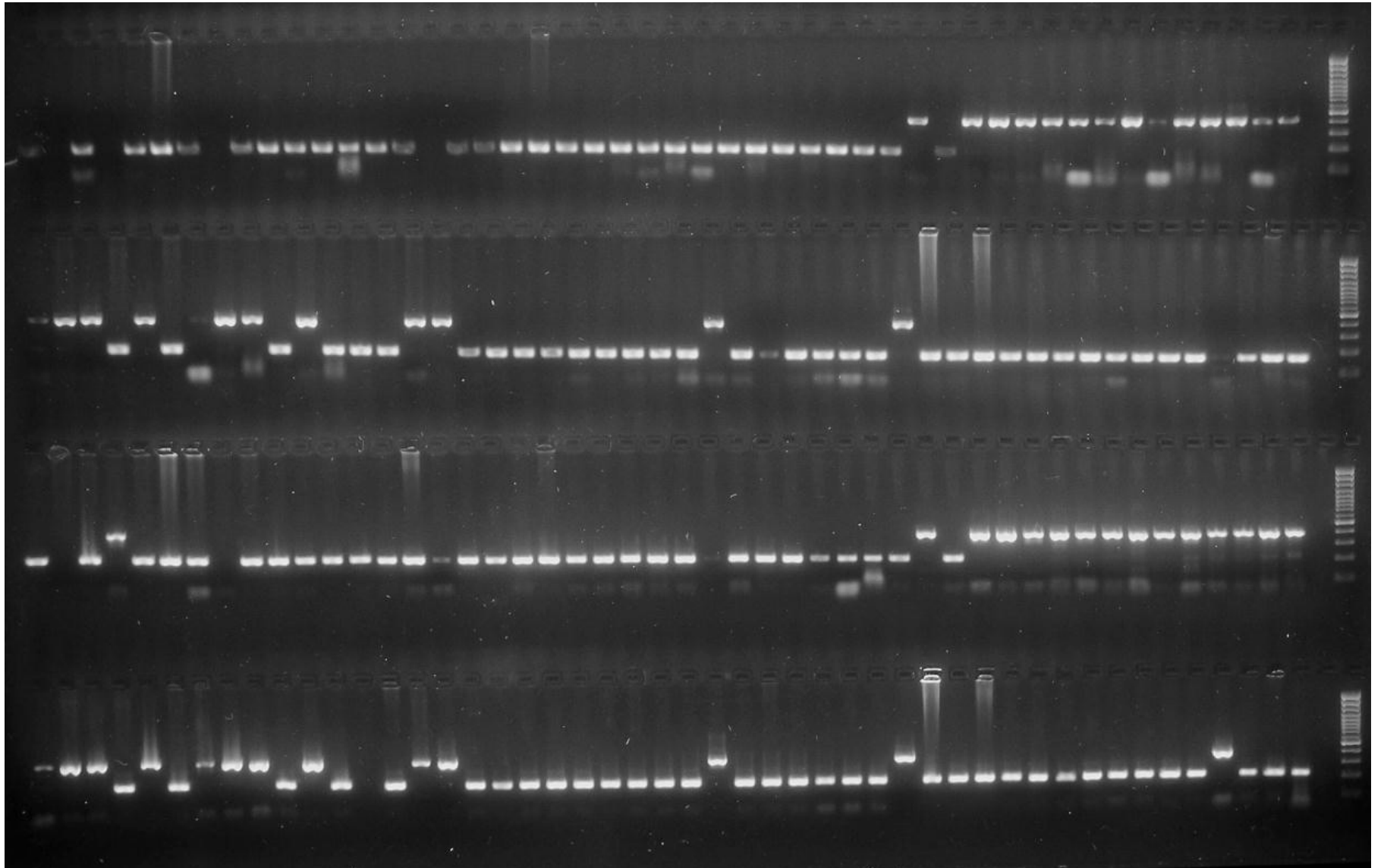
Presence or absence of the given insertion can be deduced from from the size of the amplified DNA product.

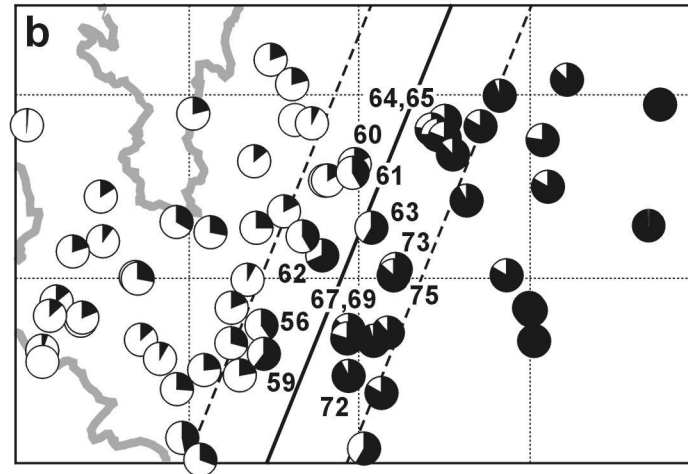
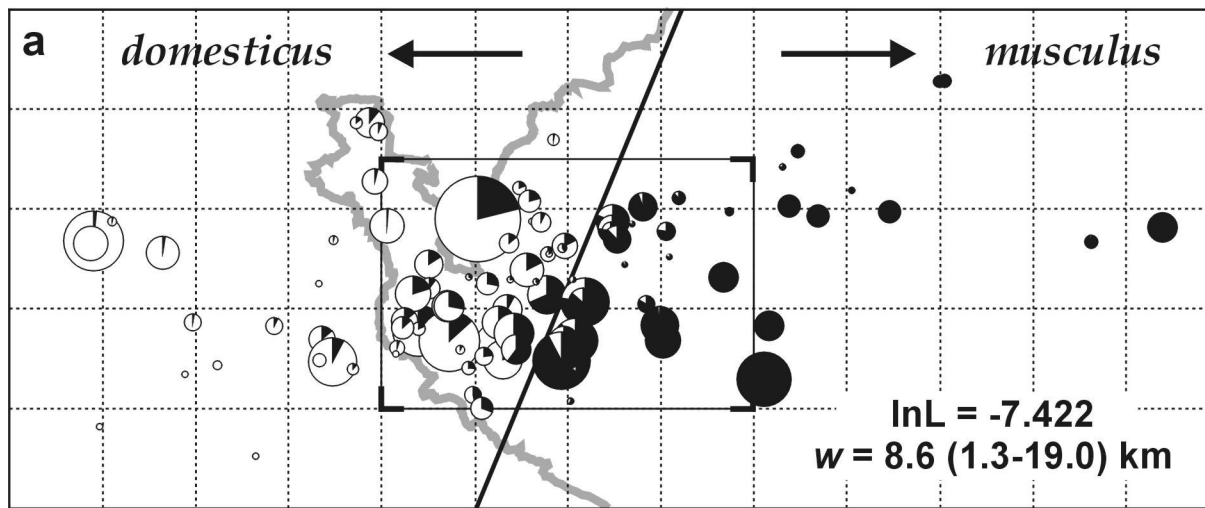
Presence = longer product



Absence = shorter product

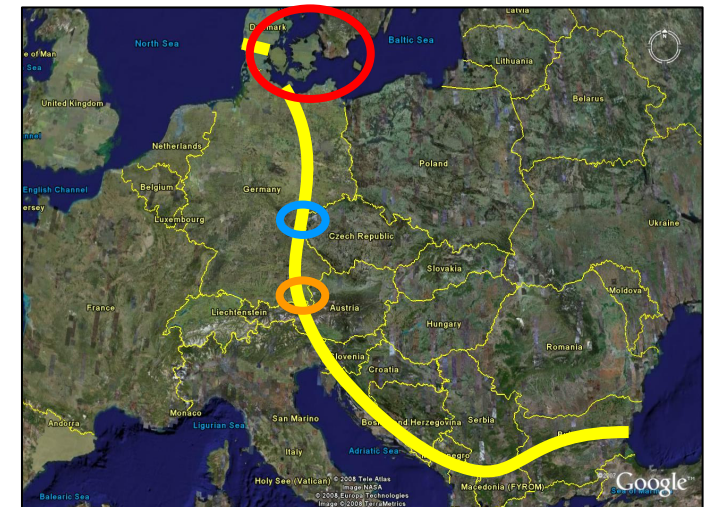
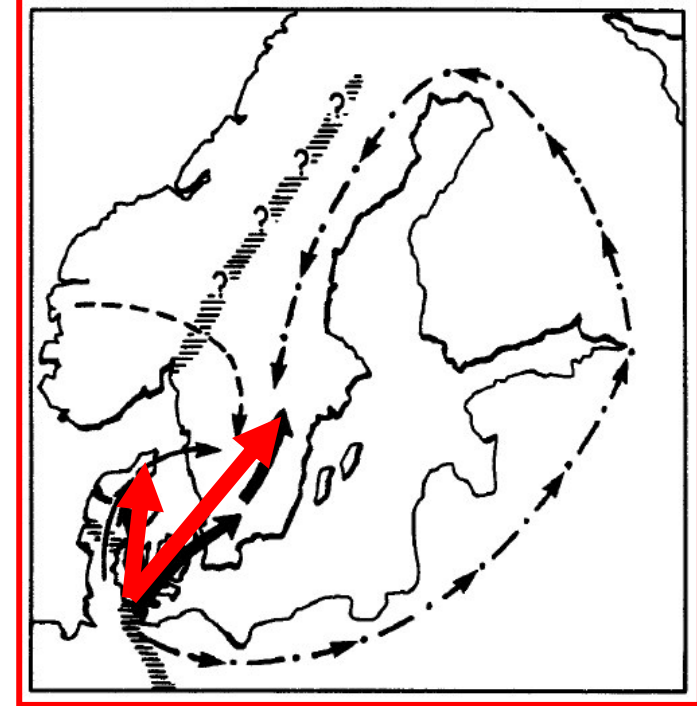
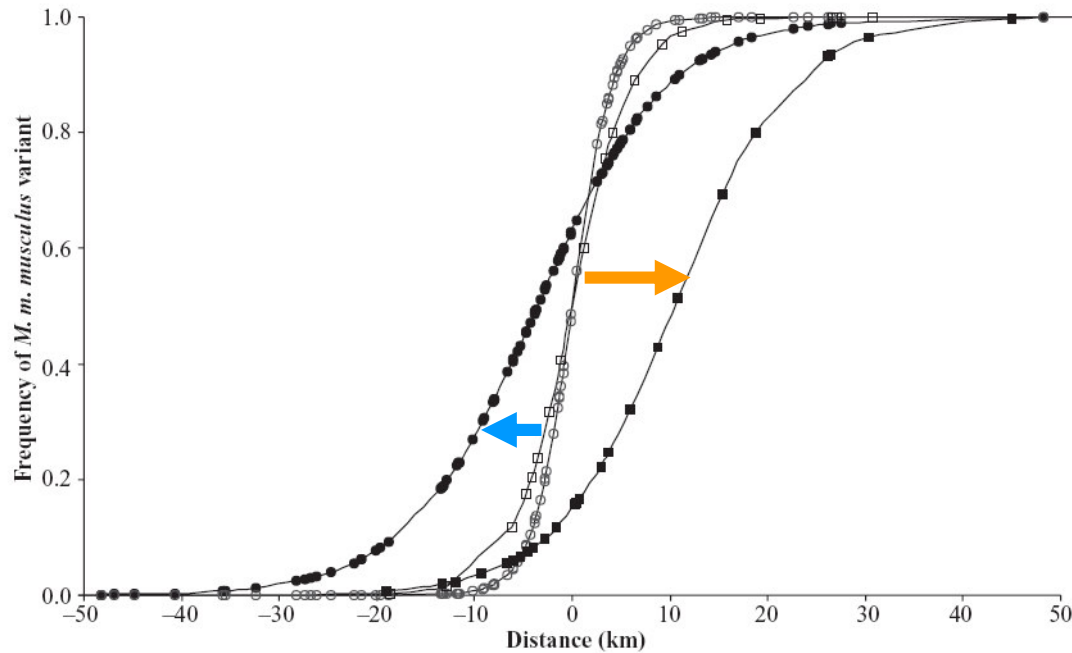






Mitochondrial DNA

- Large introgression in Jutland and Scandinavia
- Displaced clines in Bavarian and Czech transect



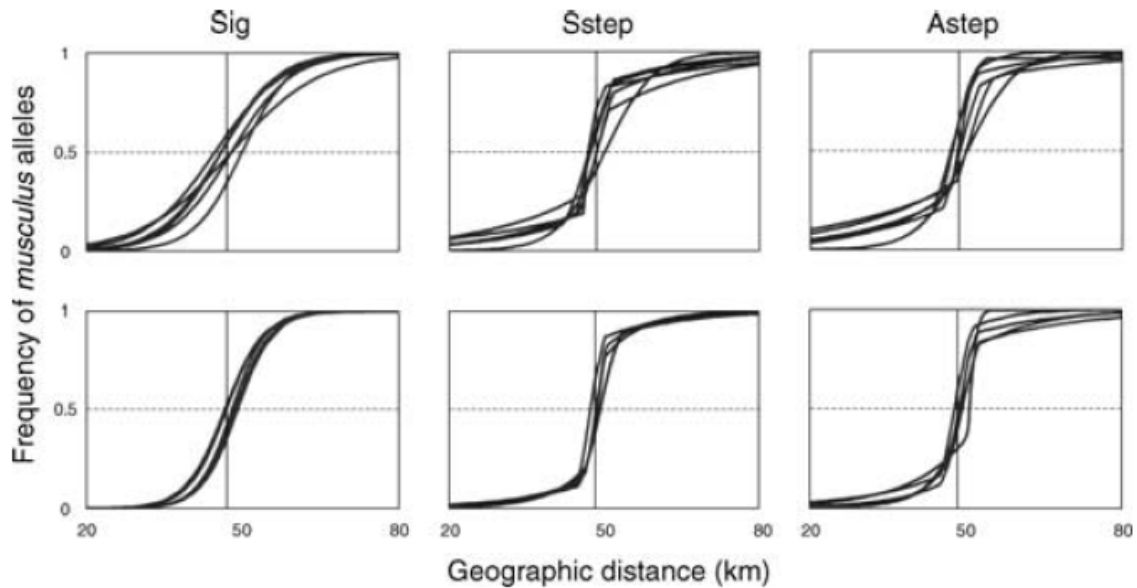
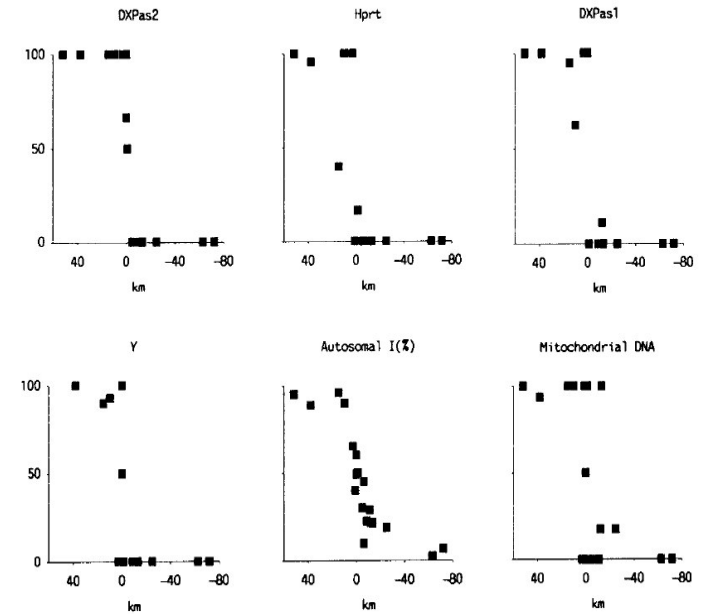
mtDNA is probably not involved in the reproductive isolation

Number of autosomal loci under selection

- Danish transect 43 -120
- Czech transect 56 -99
- Fitness of hybrids 45 and 60 %
- Similar to estimates from other hybrid zones (*Podisma*, *Bombina*)

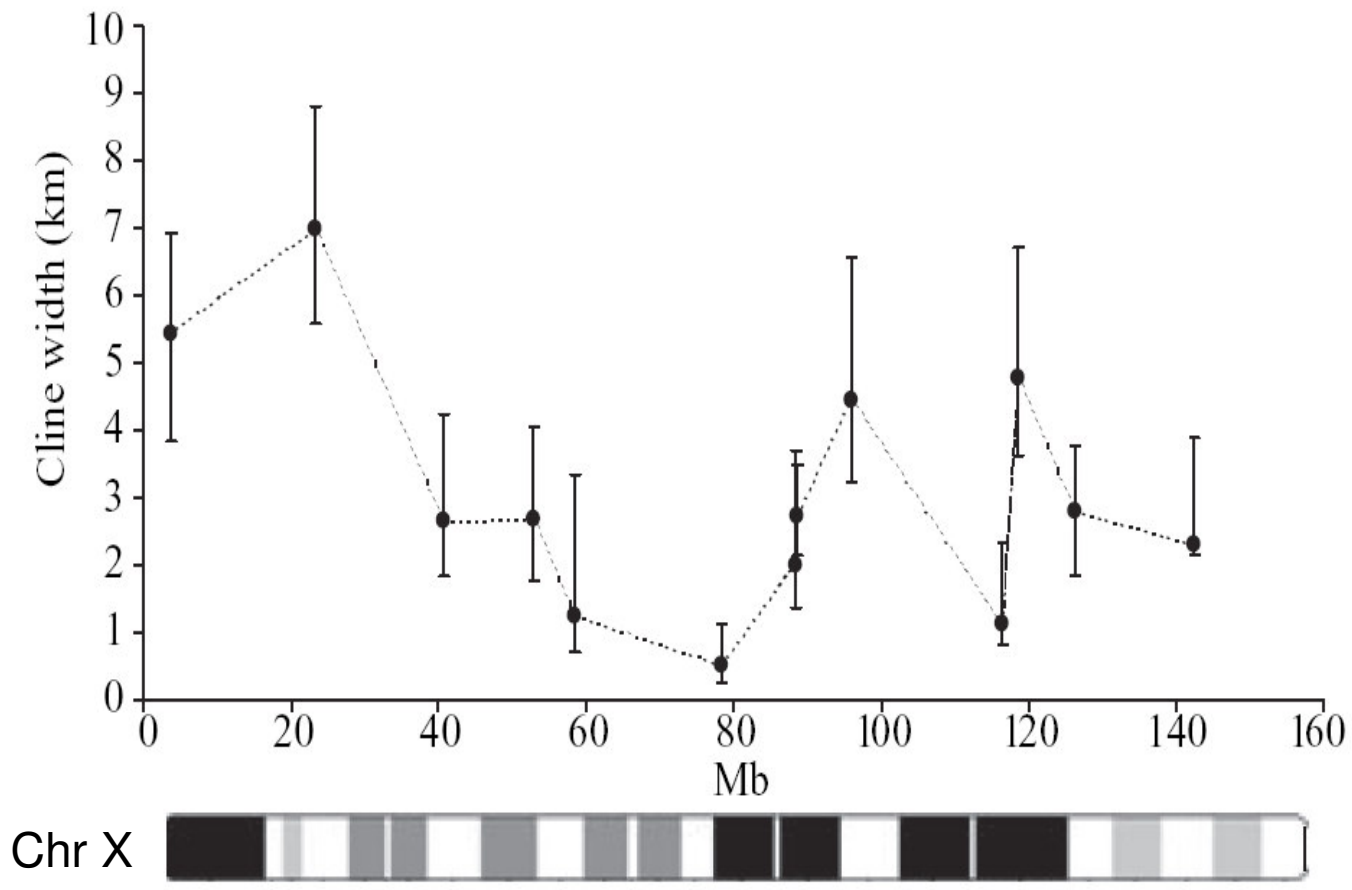
Large X effect

- Steep Chr X clines found in Germany and Denmark (*Dod et al. 1993, Tucker et al. 1993*)
- Czech transect:
Selection on Chr X 3.5-times higher



Allozymes

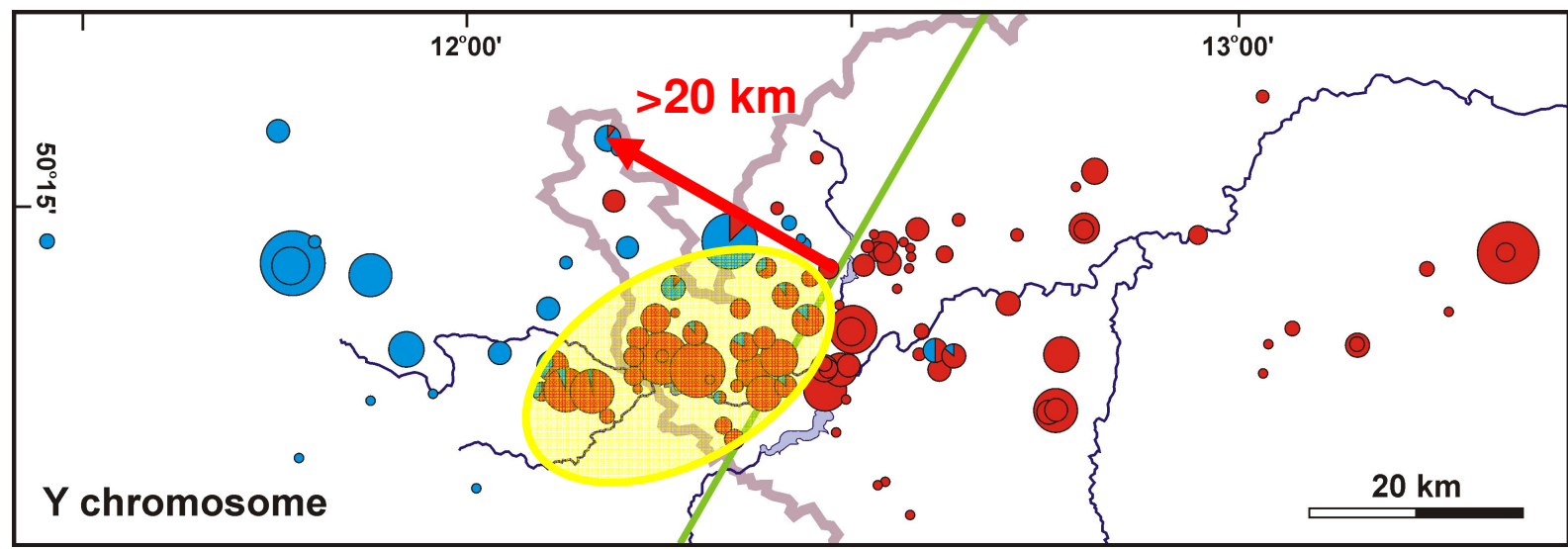
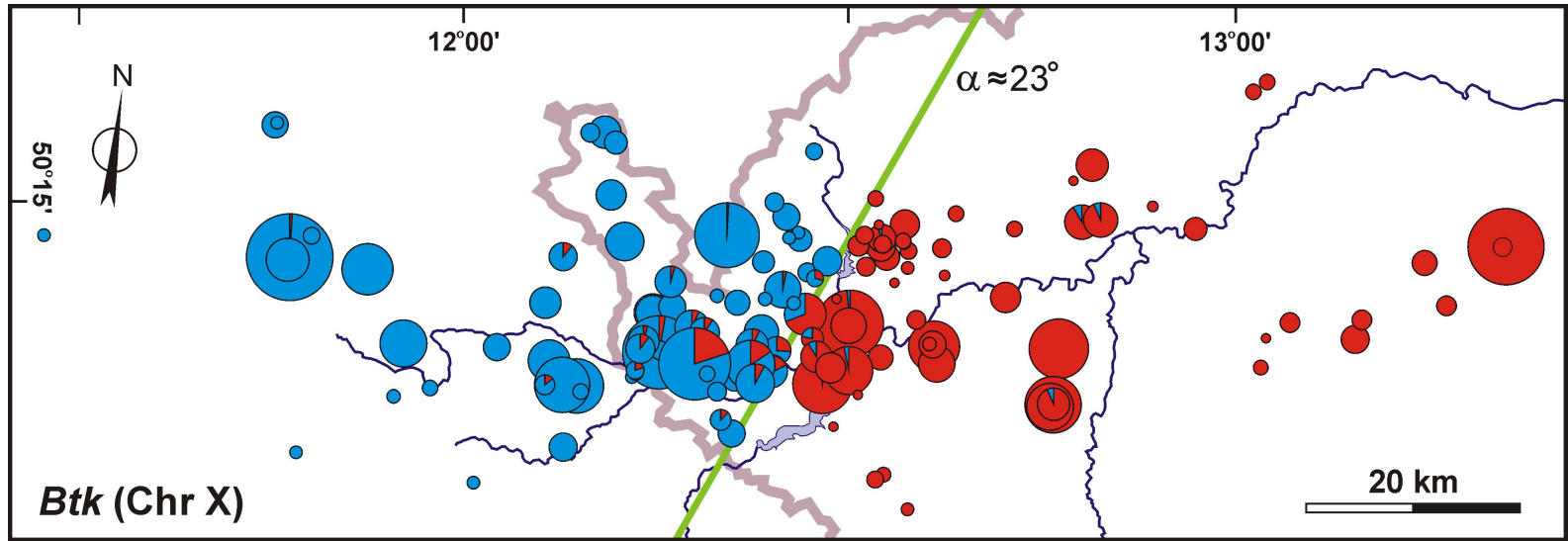
Chr X

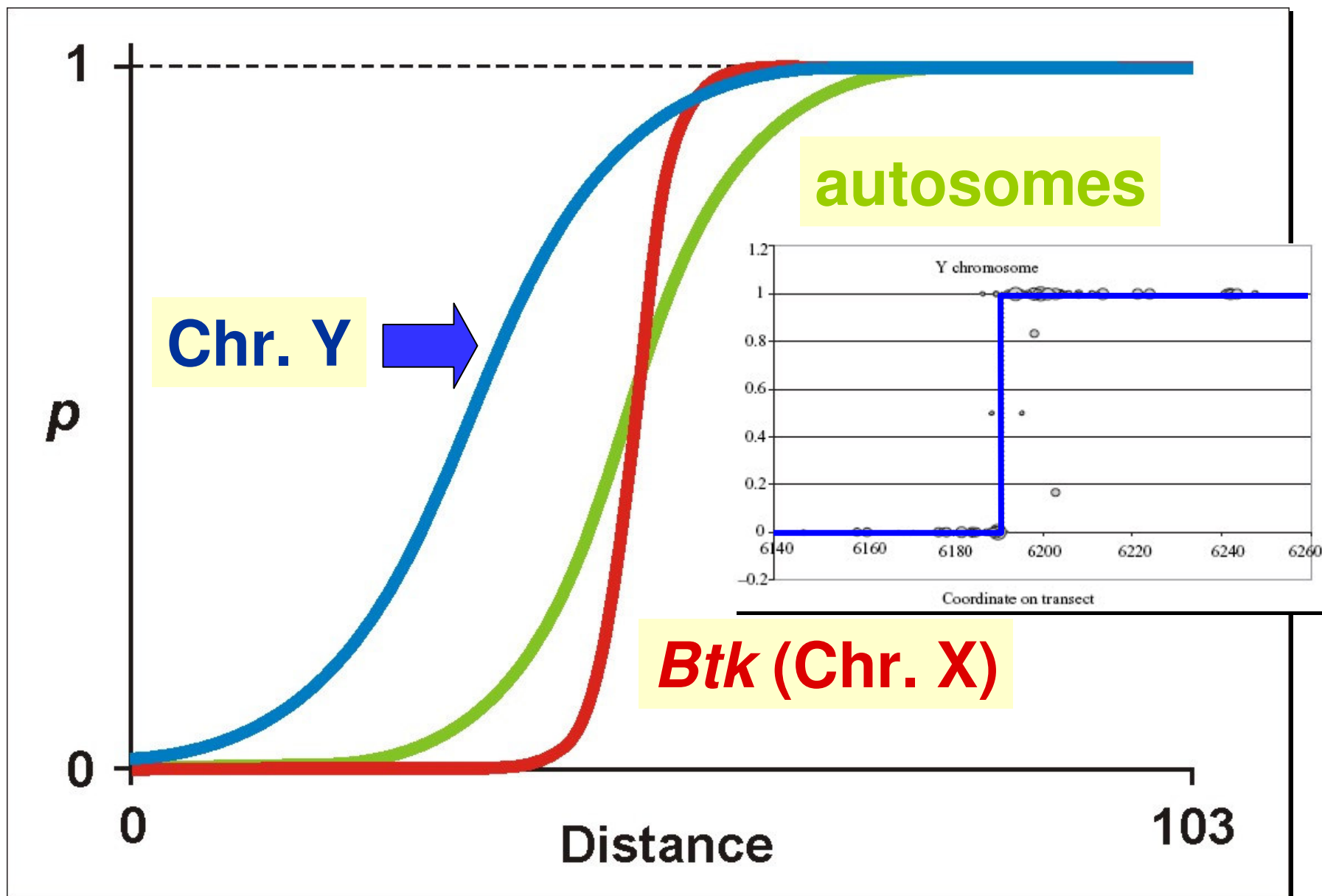


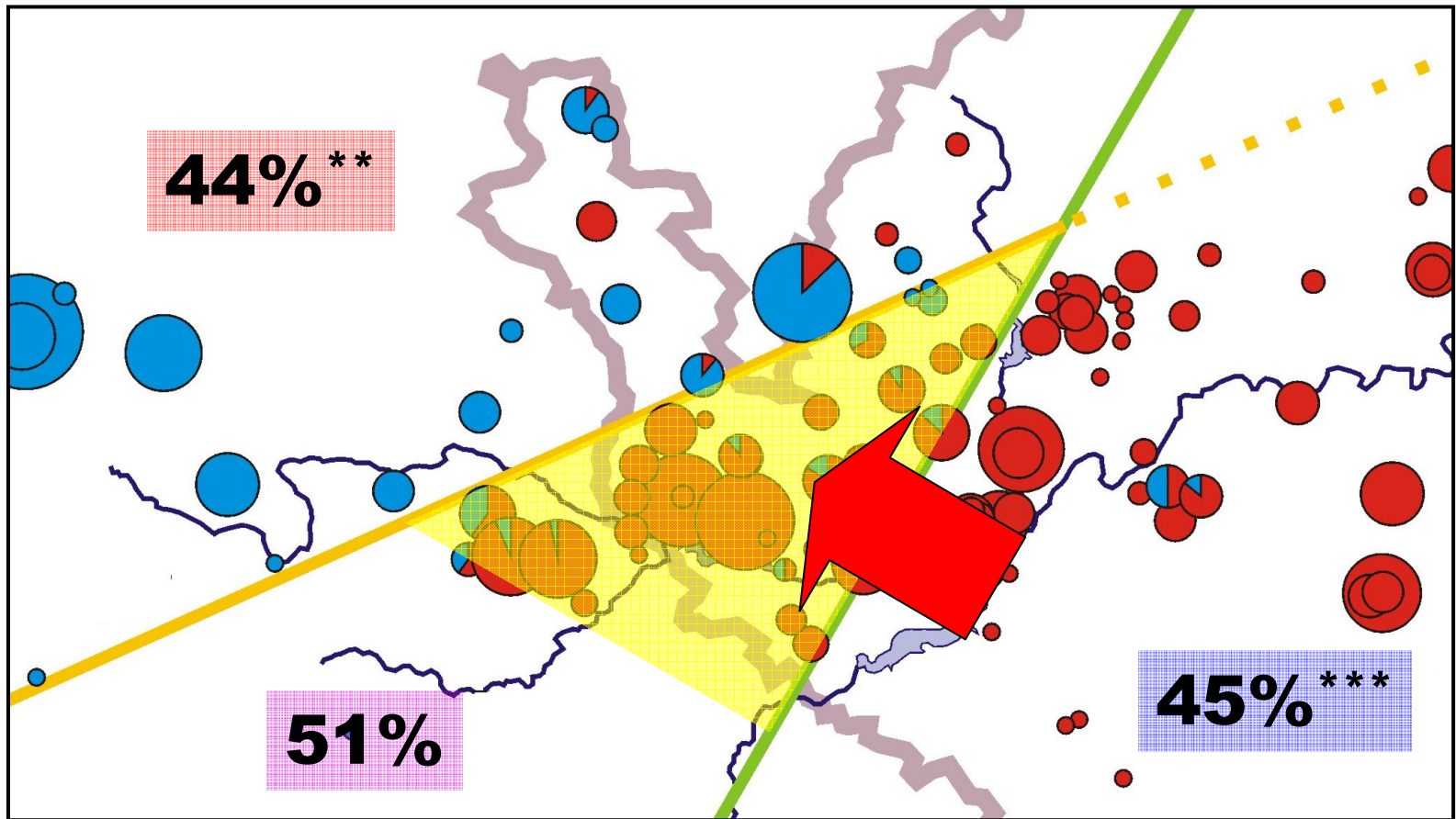
Payseur et al. 2005

Large X - additional evidence

- **Crosses of inbred lines**
(some of them derived from wild mice)
- Chr X and sterility
- Good agreement with hybrid zone studies
- Interaction of several loci
- **High differentiation of Chr X** between *domesticus* and *musculus*







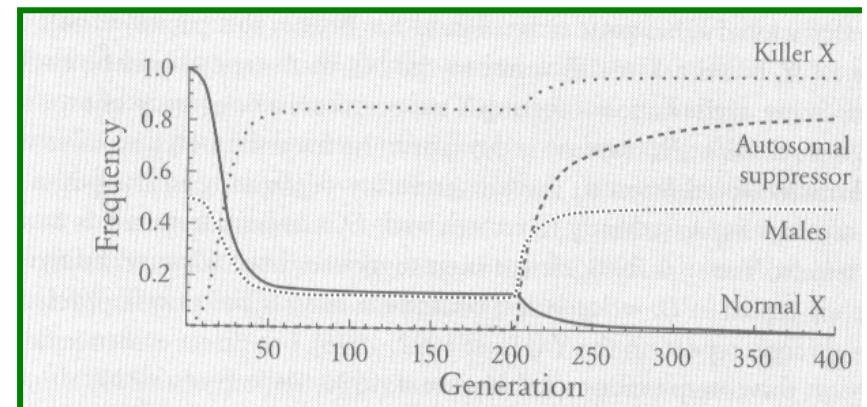
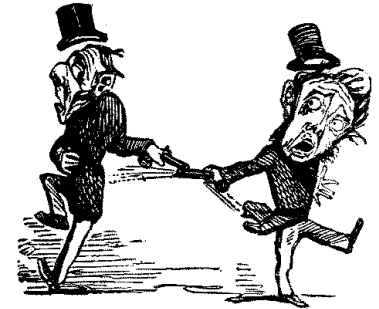
Y introgression

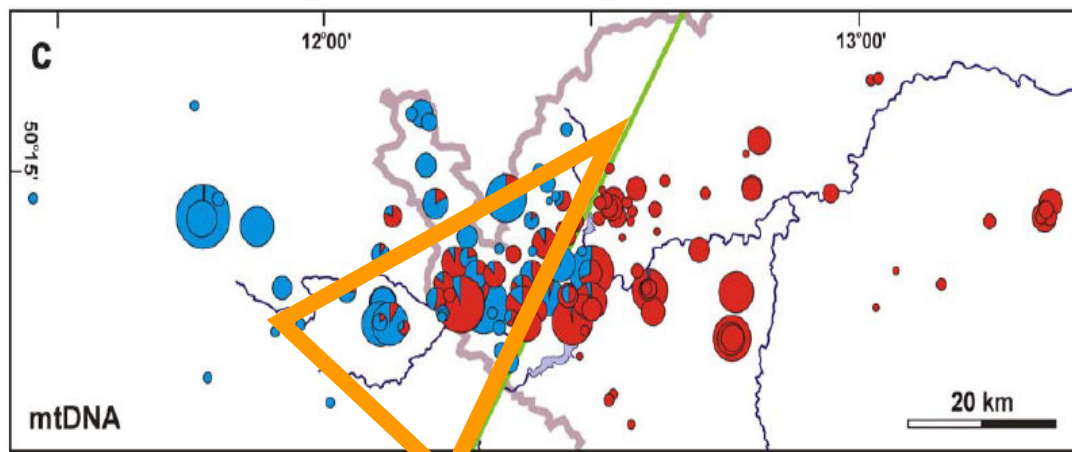
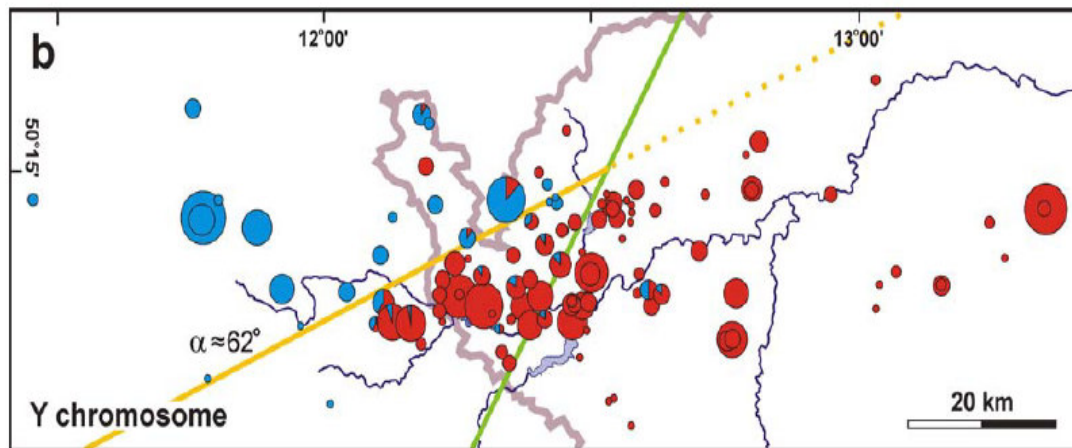
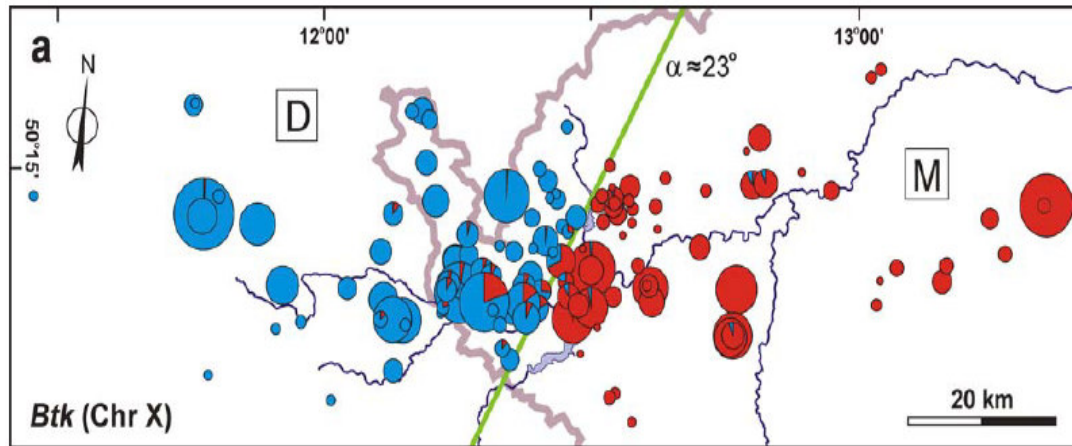
Sex ratio pattern

musculus Y on *domesticus* background increases proportion of males

Intragenomic conflict involving sex chromosomes

- Selfish elements manipulate Mendelian transmission to their own advantage
- Sex chromosomes involved → sex ratio distortion
- Drive in mice - conflict between multicopy genes *Xmr* and *Xly*
- Segregation distortion genes should spread rapidly
- Than suppressors should invade
- New distorters, new suppressors....
- Drive reexpressed in species hybrids
- → sterility of hybrids (Frank 1991, Hurst & Pomiankowski 1991)
- Orr et al. - *Drosophila too much yin*, *Overdrive* cause both male sterility and segregation distortion
- → strong reproductive barrier
- ***musculus Y* → decay of species barrier**





mtDNA pattern



- Chr Y and mtDNA are never co-inherited
- Ongoing sex chromosome races
- mtDNA hitch-hiked with female biasing distorter of the sex ratio
- Y rescued the distortion

Future

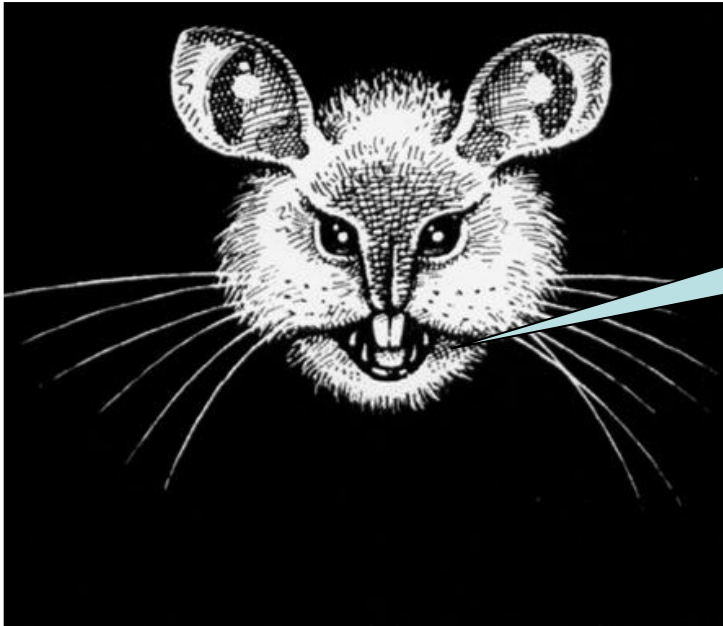


- Variability of Chr Y and mtDNA in the introgression triangle
(recent and rapid introgression → low variability)
- Intensive SNP markers typing in more transects
- Finer Chr X analyses

- Jaroslav Piálek, Miloš Macholán, Jan Zima
initiated the Czech hybrid zone study
- Jaroslav Piálek, Miloš Macholán
coordinate the research
- Stuart JE Baird
statistics
- Petra Dufková, Barbora Bímová,
Eva Božíková, Radka Storchová...

- **acknowledgement**
- Grant Agency of the Czech Republic
- People in the hybrid zone
- Czech mouse group





Thank you
for your attention

